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The Border Effect in the Japanese Market
-Gravity Model Analysis-

by

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Abstract

This paper analyzes the border effect, which indicates how biased interregional trade is, compared with international trade, by means of the Gravity Model. The border effect reveals how open to the foreign countries the nation is. This research suggests that the border effect in Japan is much lower than that of the US and Canada, and has declined year by year. Furthermore, in 1990, the border effect faded out. These trends may be reflected by international incidents such as the surge of the foreign direct investment to Asian countries and the decline of tariff rate.

Keywords: Gravity Model, border effect, interregional trade, international trade

JEL Classification Number: F14 F17 R12

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1. Introduction

Many economists strongly believe the existence of national border effect and some impediments of trade on border, though making every effort to reduce the rate of tariff leads lower border effect in economic activities. McCallum (1995) suggested that provinces in Canada trade more with other provinces than with the U.S.. It was estimated by the gravity model that inter-provincial trade is approximately 22 times as large as international trade with U.S.. This extremely large value shocked those who believe that a free trade economy can be realized by much arduous effort to reduce the rate of tariffs and transportation costs, although to some extent trade impediments still remain. Then, in this paper, the border effect in Japan is examined because Japan is said to be and criticized as one of the most closed markets in the world[1]. If the proposition by McCallum (1995) were generally correct, the Japanese market would be a perfect example and, what is more, the value of national barriers would be much higher than that calculated by McCallum (1995). Our research analyzes whether a national border exists or not, high or not and also generalizes empirical studies by McCallum. This paper focuses on the border effect from the viewpoint of international trade and interregional trade in Japan by means of the gravity model.[2] The model is

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[1] The border effect cannot directly lead to the discussion on the market openness, because the border effect includes not only the degree of openness but also differences in transaction costs and product characteristics between internal and international transactions. However, in reverse, if the market has so high trade impediments, it affects the higher border effect very much.

[2] Some works are applied to the Gravity Model in international trade. Eaton and Tamura (1994)

estimated both on all tradable goods and on manufactured goods which are composed of textile, metal, machinery, and chemical industries.[3]

There exist a few empirical studies on home country bias using the gravity model. Helliwell (1995) revised McCallum (1995) and extending the time series analysis in each year from 1988 to 1994, concluded that the inter-provincial (interregional) trade in Canada is much larger than the international trade between the U.S. and Canada, although this deviation is diminishing slightly year by year[4]. Wei (1996) analyzed home country bias in the goods market among OECD countries from 1982 to 1994, and concluded that transactions in the home country market were about 2.5 times as large as imports from foreign countries, but this home country bias is slowly but steadily declining in many countries. Particularly, the home country biases of the countries in the EC have declined by 50%.[5] The common result of these former studies on home country bias is that trade barriers in the countries have been reduced steadily but still exist.

Then our study focuses on the border effect in Japan, which means the

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demonstrated that the import protections in Europe caused an increase in foreign direct investment (FDI), and that the barriers to FDI in Japan cause the U.S. to export to Japan. Bougheas et al. (1999) demonstrated in the revised framework of the gravity model that the accumulation of infrastructure increases the volume of trade, which is a similar effect to the decline of transportation costs. Karemera et al. (1999) showed that sub-regional pacts like ASEAN and NAFTA stimulate trade creation and trade diversion effects.

[3] All tradable goods are defined as manufactured goods as is defined above also including agriculture, food product, and mining.

[4] McCallum (1995) lacks points where international trade was not treated as the foreign trade to other countries other than the US. This may result in overestimated values.

[5] Wei (1996) estimated that in OECD countries, the transaction in their own country is 2.5 times as active as the trade with foreign countries in the goods market, which figure is known as the home bias. Though this value is very small, the methods have serious problems. It did not take into account the regions in one country and interregional trade between regions, and the difference between interregional trade and intra-regional trade.

intensity of interregional trade, compared with that of international trade. The way of the analysis has main 4 characteristics. First, interregional trade in Japan is considered like McCallum (1995). Second, the term of the estimations is much longer—from 1960 to 1990—than any other former study. Third, this includes the international trade not only with developed countries and OECD countries, but also with the countries all over the world other than former studies. Finally, various ways of regression are attempted in order to robust estimations, including the Asia dummy or testing structural change.

This research provides some interesting conclusions. First, interregional trade is more active than international trade with other foreign regions in the world, but this bias has slightly declined over time. Second, the interregional trade bias disappeared in 1990, and it may come from other factors than the process to achieve free international trade, such as the increase of FDI and counter imports. It may also come as a result from bias openness toward specific foreign countries rather than all foreign countries. Third, in the process of the decline of the bias to interregional trade, the structural changes of the Japanese market occurred some times. Finally, most crucial and surprising point is to observe much lower border effect than McCallum's case.

This paper has 7 sections. In the next section, data and methodology of main regressions are explained, and in section 3, the results of estimations are supposed. Section 4 refines the results of estimations in section 3 by including the Asia dummy. Furthermore, in section 5, some additional regressions, like border effect in Okinawa prefecture and the test of structural change by chow test, are introduced in order to fortify the results in the former sections. In Section 6, we construct how results of the regressions are correspondent to some incidents from

the viewpoint of economic history on the Japanese market and trade. In the last section, results and further research are proposed.

2. Data and methods

The analyzed terms are from every 5 years from 1960 to 1990. The samples in main regressions in the next section are from 8 regions in Japan—Hokkaido, Tohoku, Kanto, Chubu, Kinki, Chugoku, Shikoku, and Kyushu— and 9 areas in the world –East Asia and the Pacific, South Asia, the Middle East, Eastern Europe and Central Asia, the rest of the Europe, the Americas, East and Southern Africa, West Africa, and North Africa, which are categorized by the World Bank[6].

The source of the data on international trade comes from the trade volume of Japan[7]. The source of the data on interregional trade comes from Input Output Tables of Interregional Relations[8]. On the data of GDP, each GDP of the 9 areas in the world is the aggregated nominal GDP of the main trade partners included in the area, and each GDP for the 8 regions in Japan is the aggregated GDP of each prefecture included in each region. Distance data in interregional trade is measured by the distance between the cities holding the prefectural offices in the prefectures which have the largest total income in each region. Distance data in international trade is measured by the distance between Tokyo and the capitals

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[6] See Data Appendix 1 and 2.

[7] The export and import data come from the research by the World Bank.

[8] The tables are published by MITI in every 5 years. This data causes the regressions to limit every 5 years from 1960 to 1990.

weighted by GDP in each country.[9]

However, the data and methods have some qualifications. The weakest point exists in data about values of export and import between each region in Japan and each area in the world. There is data on export and import between Japan and foreign countries, and as well as aggregated values of export and import in each region, but data on exports and imports between each region in Japan and the specific foreign countries do not exist. Therefore, in this paper, assuming that habitants in each region have the same utility function and technology is same in all of the regions, like the studies on the Heckscher-Ohlin-Vanek (HOV) theorem, data on exports and imports between each region in Japan and the foreign countries is measured using the figures of export and import in each region weighted by export and import between Japan and the area in the world[10].

One more limitation exists in the distance data, which is a peculiar problem of the gravity model rather than that of this thesis. Distance is measured without regard to the difference of geographical changes such as mountains, lands, and seas, and with no regard to the difference of transportation—by ship, by air, and by land. In addition to it, an inevitable problem lies in the geographical position of Japan in the world. The interregional trade distances are smaller than all the international trade ones: some interregional ones is less than 1000 kilometer,

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[9] The data—the input-output table of interregional relations, distance data in the world and Japan— are provided by Professor Kyoji Fukao (Hitostubashi Univ.) and Professor R.Helg(Bocconi Univ.)

[10] This hypothesis is not so serious and not so unreasonable, compared with the country level analysis by HOV theorem. This is because Japan is a geographically confined island country and many companies have many firms and establishments in each region, so the gap of technology among regions is small. Also this is because habitants moves among regions easily and freely, so

whereas some international ones are close to 10000 kilometer. These discrepancies affect the results of the regressions crucially.

The gravity model is used in the same one as in preceding theses. In this paper, the gravity model is the following log linear type function.

$$\log(\text{volume of trade}) = c + \alpha \log(\text{GDPe}) + \beta \log(\text{GDPi}) + \gamma \log(\text{distance}) + \zeta \, \text{dummy(Japan)} \quad (2)$$

GDPe means GDP of region or area that exports goods, and GDPi presumes GDP of region or area that imports goods. Japan dummy relates to interregional trade. In the case of interregional trade in Japan, the value of dummy is set to be unity, whereas the value is zero in the case of international trade.

If the coefficient of Japan dummy is positive and significant, a Japan market bias (=border effect) exists and the interregional trade in Japan is more active than international trade. This index demonstrates the degree of closedness of the Japanese market.

3. Estimation and Analysis

Table 1 shows the results of OLS on the gravity model for all tradable goods. In all of the cases except 1990, the coefficients of the Japan dummies are significant and positive. In 1960, interregional trade is about 8.6 (exp2.15) times[11]

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the difference of tastes are not so large.

[11] Calculations of all estimation values by exponential are shown in Table 2.

as large as international trade. In 1965 and 1970, it increased to respectively 8.85 and 10.38 times. In 1975 it fell to about 5.15 times. And taking a nosedive, in 1980 it was only about 3.6 times, slightly increasingly in 1985 to about 4.58 times. From this estimated value, we can conclude that the trend of the Japan dummy is generally decreasing year to year since 1970, though it sometimes fluctuates slightly, shown in the graph of Figure 1. Most important is the case of 1990. In 1990, the Japan dummy is not significant at the 5% level, though the other samples are all significant. Surprisingly, we cannot observe any border effects, which contradicts many empirical studies such as McCallum (1995), Wei (1996), and Helliwell (1995). This may imply that interregional trade in Japan is nearly indifferent to international trade[12].

[12] We should notice that this result does not mean the volume of international trade surpasses that of interregional trade and border effect is also reflected by other factors such as distance and GDP of each country.

Table 1

Gravity Model including Japan dummy for all tradable goods

Independent variables	1960	1965	1970	1975	1980	1985	1990
Constant	-3.48	-3.60	-5.77	-7.09	-11.773	-15.66	-15.68
	[-1.53]	[-1.55]	[-2.31]**	[-2.71]**	[-4.73]**	[-7.02]**	[-4.63]**
GDPE	0.64	0.61	0.69	0.87	0.95	1.01	1.42
	[12.77]**	[12.06]**	[12.06]**	[14.56]**	[14.481]**	[17.98]**	[15.38]**
GDPI	0.46	0.46	0.47	0.45	0.75	0.88	0.84
	[9.19]**	[9.07]**	[8.16]**	[7.46]**	[11.37]**	[15.76]**	[9.11]**
Distance	-0.53	-0.47	-0.35	-0.49	-0.73	-0.72	-1.49
	[-2.88]**	[-2.67]**	[-1.87]*	[-2.48]**	[-4.37]**	[-4.96]**	[-6.21]**
Japan	2.15	2.18	2.34	1.64	1.28	1.52	-0.41
	[3.69]**	[3.86]**	[3.96]**	[2.69]**	[2.44]**	[3.32]**	[-0.56]
R-squared	0.70	0.67	0.67	0.69	0.72	0.81	0.73
Standard Error of Regression	1.16	1.12	1.30	1.32	1.15	1.00	1.69
Number of Observations	200	200	200	200	200	200	200

[ ]: t-value

** represents significance at the 5% level.

*represents significance at the 10% level.

Table 2 Calculation of Border effect

Border Effect (times)(=exp(the coefficient of Japan dummy))

	1960	1965	1970	1975	1980	1985	1990
Tradable	8.57	8.85	10.38	5.15	3.60	4.58	0.66

Figure 1 Border Effect on Tradable Goods

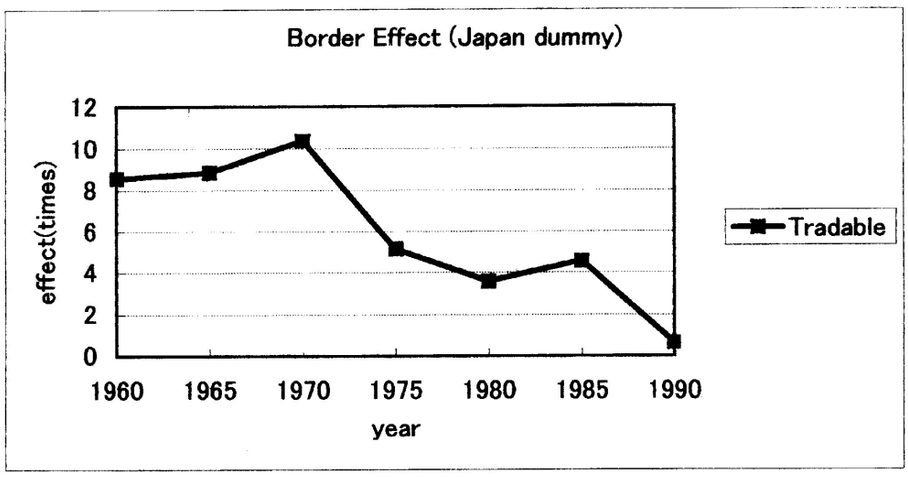


Table 3 presents the results of OLS on the gravity model of manufactured goods. Like the case of tradable goods, coefficients of Japan dummies are significant and positive in all of the cases except 1990. In 1960, interregional trade is about 60.7 times as large as international trade, which is obviously much more than McCallum's case—twenty two times to be exact. In 1965, it increased to about 97.5 times. In 1970 it decreased to about 46.5 times. More drastically decreasing, in 1975 it reached 16.8 times. Decreasing in 1980, it was about 12.9 times, although it increased again in 1985 to about 16.2 times. From this estimated value, we can conclude that the trend of the Japan dummy is a sharply decrease, even though it sometimes fluctuates slightly. From 1975, the values are less than 22 times, which goes below McCallum (1995)'s case. Most important is the case of 1990. In 1990, the coefficient of the Japan dummy is not significant at the 5% level, and very small (the coefficient is 0.34 and the value of the effect is 1.42 times). We cannot observe any border effects like the case of all tradable goods. There is the possibility that international trade becomes almost as active

as interregional trade in Japan.

From Figure 2, we can draw three conclusions. First, interregional trade is more active than international trade, because coefficients of dummies are positive and significant in most of the cases. But interregional trade is not so brisk, compared with McCallum's work in which interregional trade is 22 times as large as international trade. The border effect value between Canada and the US is almost always higher than that of Japan. So we can say that the Japanese market is not so closed. In fact, the Canada-US market is more closed. Next, the Japan bias is beginning to disappear steadily, and for recent years a bias is not observed. The Japanese market is becoming open, even though it has been said to be criticized for being too closed. Finally, concerning the fact that Japan dummies are significant, the Japan dummy on tradable goods is always much lower than that on manufactured goods, which is surprising because of the much more closed in the Japanese agricultural market and because of the more open in the Japanese Manufacturing goods market. This implies that agglomeration and industrial districts are formed and the interregional trade in manufacture is active, whereas agricultural goods are produced in each region and the interregional trade in agriculture is less active than in manufacture.

Table 3

Gravity Model including Japan dummy for manufactured goods

Independent Variables	1960	1965	1970	1975	1980	1985	1990
Constant	−11.19	−12.43	−12.47	−11.28	−17.73	−22.6	−18.12
	[−2.97]**	[−3.01]**	[−4.47]**	[−3.70]**	[−7.12]**	[−9.20]**	[−6.09]**
GDPE	0.68	0.60	0.76	0.84	0.95	1.06	1.42
	[8.16]**	[6.65]**	[11.94]**	[12.13]**	[14.44]**	[17.14]**	[17.45]**
GDPI	0.69	0.71	0.61	0.57	0.92	1.08	0.87
	[8.28]**	[7.79]**	[9.49]**	[8.18]**	[14.01]**	[17.46]**	[10.67]**
Distance	−0.24	−0.03	−0.08	−0.28	−0.47	−0.51	−1.30
	[−0.79]	[−0.10]	[−0.36]	[−1.24]	[−2.79]**	[−3.16]**	[−6.15]**
Japan	4.11	4.58	3.84	2.82	2.56	2.78	0.35
	[4.28]**	[4.55]**	[5.84]**	[3.97]**	[4.87]**	[5.52]**	[0.54]
R-squared	0.57	0.49	0.69	0.66	0.75	0.82	0.78
Standard Error of Regression	1.92	2.14	1.45	1.53	1.16	1.10	1.49
Observation	200	200	200	200	200	200	200

[ ]: t-value

**represents significance at the 5% level.

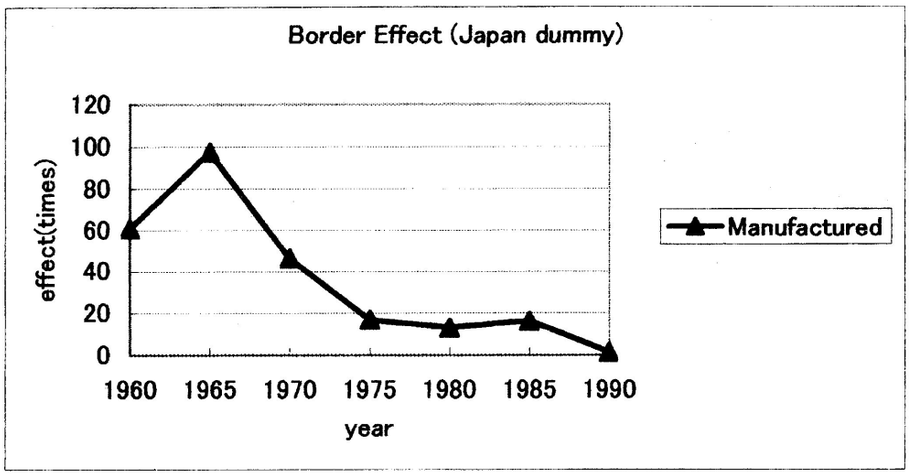
*represents significance at the 10% level.

Table 4 Calculation of Border effect

Border Effect (times)(=exp(the coefficient of Japan dummy))

	1960	1965	1970	1975	1980	1985	1990
Manufactured	60.76	97.51	46.45	16.80	12.96	16.17	1.419

Figure 2 Border Effect in Manufactured goods



4 More Analysis on the Test

The most surprising sample is the non-significant Japan dummy for both tradable goods and manufactured goods in 1990. Does this mean that in 1990 or since around 1990, the border effect is really disappearing? Can it imply that interregional trade is indifferent to international trade? More analysis is needed on this issue.

We can assume some underlying reasons for the insignificant dummies. One major aspect may be the increase of FDI. In the latter half of 1980, FDI increased drastically, and it caused augmentation of re-importation and intra-firm trade[13]. Such a situation may make international trade more active. Then we introduce the Asia dummy to examine the degree of trade bias in international trade toward Asian countries which would result from the increase of FDI. The

equation for estimation is basically the same as in the preceding section.

$$\log(\text{export}) = c + \alpha \log(\text{GDPe}) + \beta \log(\text{GDPi}) + \gamma \log(\text{diatance}) + \zeta\, \text{dummy(Japan)} + \eta\, \text{dummy(Asia)} \quad (3)$$

Table 5 shows the results on tradable goods including the Asia dummy. In this regression, Japan dummy indicates the border effect, as in the last section, and Asian dummy implies the degree of bias to the trade with Asian countries in international trade in Japan. The two dummies decrease in 1980 and level in 1985. In 1985 the Japan bias is about 10 times and Asian bias is about 4 times and also smaller than the case of McCallum (1995). Table 6 calculates the border effect, which is induced by exponential of the coefficient of the dummy. Until around 1985, the value of the Asia dummy is small—about 4 times. However, in 1990 it goes up to 22 times, and exceeds that of the Japan dummy[14].

Table 7 shows the border effect of manufactured goods including the Asia dummy. This is similar to the preceding case. The Japan dummy decreases, though it is larger than in the case of all tradable goods. Also the Japan dummy is larger than the Asia dummy until 1985. The border effect which is induced by the exponential of the coefficient of the dummy like Table 8.

Most important in this section is the sample for 1990, where the Japan dummy is not significant at the 5% level as in the last section. Taking the Asia dummy

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[13] This is reconsidered in section 6. See Figure 5 about the increase of re-importation.

[14] This does not imply that the volume of trade with Asian countries surpassed that of interregional trade in Japan. This shows the border effect, which is reflected not only the volume of trade but also GDP and distance.

into account, the Japan dummy becomes significant in both cases of all tradable goods and manufactured goods. Furthermore Asian dummies go up in 1990, as we can see in Figure 3 and Figure 4. This implies that international trade is biased toward Asian countries, and the Japanese market may still be closed to other countries. This surprising fact manifests that the Japanese market is inclined towards Asian countries, but not totally open to other countries in the world. This analysis may indicate that since the latter half of the 1980's FDI increased and this resulted in increasing re-importation and intra- firm trade.

Table 5

Gravity Model including Japan dummy and Asia dummy for all tradable goods

Independent variables	1960	1965	1970	1975	1980	1985	1990
Constant	-6.16	-6.31	-9.28	-10.33	-14.49	-18.36	-24.71
	[-2.86]**	[-2.65]**	[-3.62]**	[-3.93]**	[-5.94]**	[-8.42]**	[-7.38]**
GDPE	0.64	0.61	0.68	0.86	0.931	0.99	1.46
	[13.71]**	[12.24]**	[12.36]**	[15.02]**	[14.9]**	[18.69]**	[17.41]**
GDPI	0.46	0.45	0.46	0.44	0.72	0.87	0.88
	[9.84]**	[9.16]**	[8.32]**	[7.62]**	[11.6]**	[16.35]**	[10.51]**
Distance	-0.24	-0.16	0.04	-0.12	-0.38	-0.39	-0.69
	[-1.35]	[-0.83]	[0.21]	[-0.58]	[-2.14]**	[-2.49]**	[-2.75]**
Japan	3.17	3.20	3.63	2.86	2.44	2.62	2.26
	[5.61]**	[5.17]**	[5.57]**	[4.38]**	[4.37]**	[5.37]**	[2.89]**
Asia	1.74	1.26	1.55	1.57	1.51	1.39	3.10
	[5.61]**	[3.56]**	[4.03]**	[4.21]**	[4.62]**	[4.97]**	[6.66]**
R-squared	0.75	0.69	0.69	0.72	0.75	0.83	0.78
S.E.R	1.07	1.17	1.25	1.26	1.10	0.95	1.53
Observations	200	200	200	200	200	200	200

[ ]: t-value

** represents significance at the 5% level.

*represents significance at the 10% level.

Table 6 Calculation of Border Effect

Tradable

	1960	1965	1970	1975	1980	1985	1990
Asia	5.70	3.53	4.71	4.81	4.52	4.01	22.27
Japan	23.74	24.53	37.71	17.46	11.46	13.80	9.56

Figure 3 Asian biased Effect in international trade

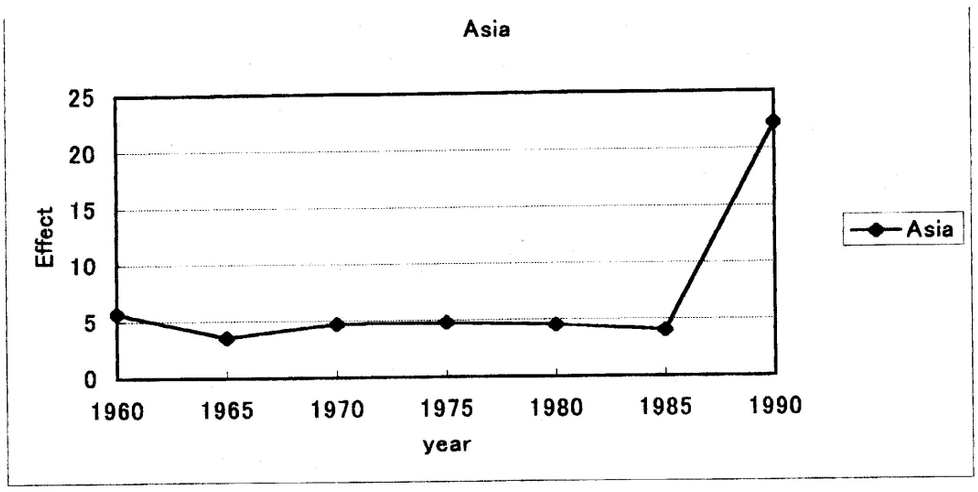


Table 7

Gravity Model including Japan dummy and Asia dummy for manufactured goods

Independent Variables	1960	1965	1970	1975	1980	1985	1990
Constant	-14.87	-16.19	-15.77	-14.86	-20.42	-25.4	-27.82
	[-4.07]**	[-3.77]**	[-5.45]**	[-4.84]**	[-8.35]**	[-10.49]**	[-10.02]**
GDPE	0.67	0.59	0.76	0.84	0.93	1.04	1.46
	[8.51]**	[6.63]**	[12.12]**	[12.44]**	[14.85]**	[17.69]**	[21.01]**
GDPI	0.68	0.69	0.6	0.56	0.9	1.06	0.91
	[8.63]**	[7.78]**	[9.60]**	[8.34]**	[14.35]**	[18.02]**	[13.1]**
Distance	0.16	0.40	0.30	0.12	-0.12	-0.16	-0.44
	[0.53]	[1.16]	[1.27]	[0.51]	[-0.67]	[-0.92]	[-2.11]**
Japan	5.51	5.99	5.05	4.17	3.71	3.93	3.21
	[5.75]**	[5.37]**	[6.86]**	[5.46]**	[6.62]**	[7.24]**	[4.97]**
Asia	2.39	1.74	1.46	1.74	1.49	1.44	3.33
	[4.74]**	[2.74]**	[3.36]**	[3.98]**	[4.56]**	[4.54]**	[8.62]**
R-squared	0.61	0.51	0.70	0.68	0.77	0.84	0.84
S.E.R	1.82	2.10	142	1.48	1.10	1.05	1.27
Observations	200	200	200	200	200	200	200

[ ]: t-value

** represents significance at the 5% level.

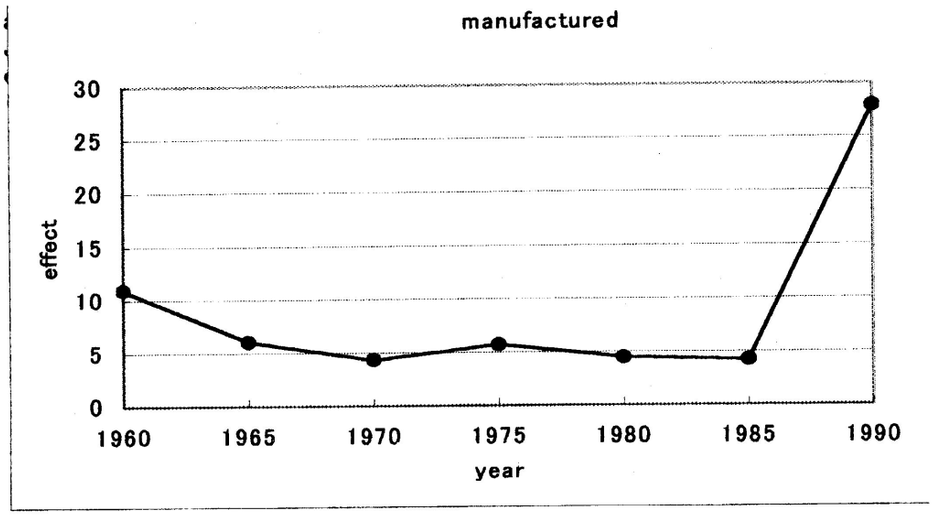
*represents significance at the 10% level.

Table 8 Calculation of Border effect

Manufactured

	1960	1965	1970	1975	1980	1985	1990
Asia	10.95	5.70	4.30	5.69	4.45	4.22	27.90
Japan	246.65	399.41	156.19	64.74	40.67	50.74	24.76

Figure 4 Asian Biased Effect in international Manufactured Goods trade



5. Some Additional Estimation for Robustness

In this section, we estimate some additional issues by gravity models in order to fortify the result of the lower border effect than in Canada and US and in order to clear up why we use cross section analysis, not time series analysis. First, Okinawa prefecture is analyzed by gravity model to overcome the lack of data of the international trade between each region in Japan and the specific foreign countries. Next, we examine whether the change of the structure occurs or not by means of the Chow Test.

Border effect in Okinawa prefecture

The following regressions in the previous sections indicate some surprising

and abundant conclusions. However, returning to methodology, the lack of the data which is international trade in each region in Japan made the data processed by using trade data in Japan and GDP in each region. Under this process, some hypotheses are supposed such as the same utility function and technology like HOV theorem. In this section, we get over this difficulty and examine robustness.

Okinawa prefecture has been classified as the 9th region in Input-Output Tables of Interregional Relations since 1975.[15] Okinawa has minute foreign trade data in 1990, which is bilateral trade between Okinawa and foreign countries covers most of the international trade.[16] Thus, we can regress the trade to 8 regions in Japan and about 40 foreign countries. Distance data is that from Naha, where prefectural office is located, to the capital of foreign countries or to the city where prefectural office is located in the prefecture which has the highest GDP in each region in Japan. The equation for this estimation is the same as equation (2) in section 3.

Table 9 shows the result of the estimation. Interregional trade is 4.7 times as active as international trade. This figure is obviously less than the case of McCallum—about 22 times. This fortifies previous results that border effect is lower than the case of McCallum. It is true to overcome shortcomings of data in previous estimations and support some following conclusions, but the coefficient of Japan dummy in Okinawa is positive and significant, and the value of border

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[15] Okinawa was replaced by the U.S. in 1972, and reverted to Japan. We can get the data related to interregional trade in Japan, which is the input-output table of interregional relations since 1975.

[16] See Data Appendix 3, which lists up foreign countries covered in the data.

effect is 4.7 times while the former estimations in other 8 regions in Japan in 1990 are insignificant. Although this seems to include slight contradiction, there is the possibility that FDI and intermediate goods trade by FDI may make small influence on Okinawa, and international trade biased to Asian countries in Okinawa may be smaller than in the Japan proper. Also, this difference may come from discrepancy of location. Okinawa is the island in East China Sea, and it is far away from Tokyo and rather closer to Taiwan and to China. This particular situation may have some influence. Consequently, most important is that we can support border effect in Japan is much lower than that of US-Canada case.

Table 9
Estimated Gravity Model in Okinawa in 1990

Const	0.75		OLS
	[1.94]*	Sample	69
GDPE	0.75	R-squared	0.623
	[3.60]**	F-statistics	26.5
GDPI	0.07	Border effect	4.71
	[0.34]		
Distance	-1.91		
	[-6.05]**		
Japan dummy	1.55		
	[2.17]**		

Test of Structural Change

In this part, we test whether structural changes occur or not in order to verify to regress by the cross section analysis rather than by the time series analysis. If structural changes are observed, we can think the environment of the Japanese market changes, which includes the change of all the variables in regressions. In

such a case, we may not use the panel analysis properly and rigorously, but it is better to use the cross section analysis in each time like in this paper.

The samples on all tradable goods in different time are pooled and estimated by Chow Test. The trend variables are inserted in estimation equation (2) in section 2, and pooled as different time samples. As Table 10 shows, in the case of 1970 and 1975, $F(6,388) = 1.26$ is less than critical value. However in the case of 1975 and 1980, $F(6,388) = 2.27$ is larger than critical value and also P-values are very small. Thus, the null hypothesis of no structural change is rejected. Between 1975 and 1980, we can confirm that structural changes have occurred. This may result from the drastic changes by the shift of industrial structure and the change of production system in each firm through two oil shocks.

Next, in the regression of 1980 and 1985, $F(6,388) = 0.48$ is not larger than critical value. Also, P-value is 0.82. Thus, the null hypothesis of no structural change is adopted. Therefore, in the term between 1980 and 1985, structural changes did not occur.

From the test of 1980 and 1985 and that of 1980, 1985, and 1990, which is divided as the pair of 1980 and 1985 and as 1990 we can see F-statistics are higher than critical value and P-values are sufficiently small. The null hypothesis of no structural change is rejected. The term between 1985 and 1990, some structural changes may occur. The strong yen since Plaza accord in 1985 may cause some changes of the structure of industries and firms.

Thus, some structural changes have occurred, and we can verify the use of the cross section analysis rather than the panel analysis.

Table 10 Chow Test

	1970–1975	1975–1980	1980–1985	1985–1990	(1980–1985)–1990
	F(6,388)	F(6,388)	F(6,388)	F(6,388)	F(6,588)
F-statistic	1.26	2.27	0.48	4.15	6.62
P-value	0.274	0.036	0.82	0.0005	0

. 6. Construction on the Estimation

How can we translate this remarkable result that the border effect has declined and at last it disappeared in 1990? Is this correspondent to historical events in international trade and economic policies?

In the first half of the 1960s, economic growth and liberalization on trade started. In 1960 the plan to double national income was announced, and in 1964 trade liberalization was almost achieved except some manufactured goods such as computers and automobiles. The rate of liberalization reached 90%.

In the latter half of the 1960s, this trend towards trade liberalization continued. Liberalization of internal investment began from 1967 to 1973. The Kennedy Round succeeded with a large rate reduction of tariffs through multinational negotiation, not by conventional bilateral negotiation. This remarkable achievement was realized as tariff rate actually started to fall from 1968.

In the first half of the 1970s, the effort to liberalize trade and investment succeeded. The burden rate of tariff was reduced drastically by 4-5 point. This influence clearly shows, as the border effect diminished sharply both in all

tradable goods and in manufactured goods like Figure 1 and 2. The great reduction of the tariff rate made international trade increase, relatively, while interregional trade remained larger than international trade. Another remarkable point to notice is the exchange rate. In 1971, the end of Bretton-Woods system occurred and in 1973, Japan changed over from a fixed rate of exchange to a flexible rate of exchange. In 1973 and 1978 the oil crisis happened, and the price of crude oil soared. This resulted in the rise of costs and prices in manufactured goods produced in Japan, and this rise of prices of manufactured goods caused a recession. This made the structure of many companies and industries change, which we can see in the last section. It lead the border effect to decline so drastically.

According to the results of the estimation, like Table 1 and 3, Figure 1 and 2, the border effect rose slightly in the first half of the 1980s. This background is in contrast to that of the 1960s and 1970s. This may result from slightly moving from trade liberalization to protectionism in the developed countries particularly in the U.S.. In this period this rise of protectionism caused trade friction in many goods. In Japan, government took measure by means of VERs in the automobile industry from 1981. This friction may have made the border effect slightly higher.

In 1985 the Plaza Accord caused the yen to appreciate drastically. This has lead relatively higher wages in Japan and the surge of FDI. These phenomena lead to an increase in the rate of re-importation not only of consumer durable goods but also of some parts of intermediate goods. The mass of re-importation in Japan has come from NIES and ASEAN. Figure 5 shows that in the latter half of the 1980s the surge of FDI encouraged re-importation to Japan. Particularly, FDI to Asian countries has lead much more re-importation than to the US and

European countries, and re-importation has grown up year after year[17]. This may make an influence of the situation that the border effect decreased and disappeared. and the Asian dummy surpassed Japan dummy in 1990 as shown in Figure 3 and Figure 4. The openness of Japan market in the latter half of the 1980 is biased towards Asian countries and a barrier towards other countries may still remain.

In addition to these incidents, the trend of border effect was consistent to the trend of the reduction of tariff rate in some degree. This reduction is shown in Figure 6. From 1960 to the middle of the 1970s, we can see one hill which has peak in around 1970. This shape is similar to the curve in the Figure 1 and 2. Furthermore, from 1975 to around 1985, the shape in Figure 6 fluctuates but slowly declines, which is also similar to the shape in Figure 1 and 2, though we should discuss from both import and export side. This incident can be one of the evidences of the decline of border effect.

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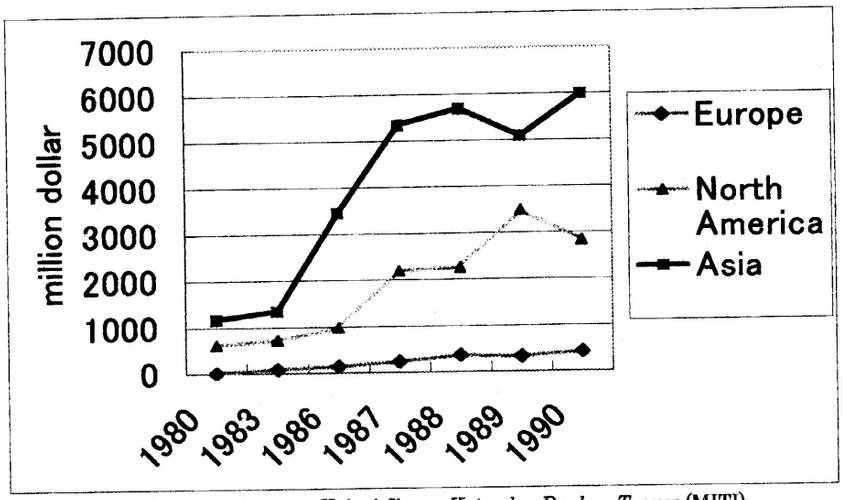
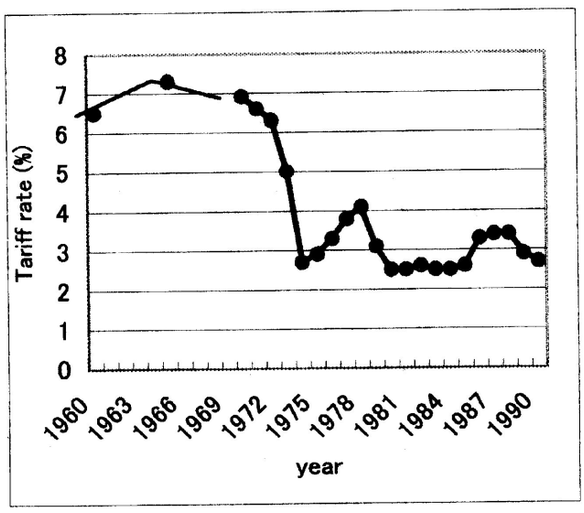
[17] Fukao and Chung (1997) concluded that FDI to Asia has encouraged re-importation and intermediate goods trade since around 1986, and it is contrast to FDI to the U.S. and European countries.

Figure 5 Re-importation to Japan by FDI



Source: *Kaigai Toushi Toukei Souran, Kaigai Jigyou Katsudou Doukou Tyousa* (MITI)

Figure 6 Tariff Rate in Japan



Source *Nihon no Genkyou* EPA * This tariff rate data is defined as the burden rate of tariff.

7. Conclusions

This paper demonstrates the border effect in Japan. Japan is said to be one of the most exclusive markets, but in fact Japan is shown to be open to foreign countries in the analysis using the gravity model. This paper has features in covering the largest number of foreign countries and the longest term than any other paper, and of analyzing both from international trade and interregional trade.

This study has four main conclusions. First, border effect in Japan is much lower than in Canada. We can conclude that international trade between the U.S. and Canada, compared to their inter-regional trade, is more closed than the same comparisons for Japan. Second, the trend of border effect from 1960 to 1990 goes down. The decline of tariff rates and non-tariff barriers may make some influence on it. Third, surprisingly, the border effect fades out in 1990. This shows that international trade and interregional trade may have become indifferent. However, it may not directly imply the perfect openness of the Japanese market, it may manifest a biased openness resulting in the surge of FDI in the latter half of the 1980s. The disappearing border effect may come only from the surge of re-importation and intra-firm trade with Asian countries. Finally, the border effect in manufactured goods is higher than that of all tradable goods. This may imply that manufacturing industries form agglomerations and products are traded between regions, whereas agricultural products tend to import from foreign countries and to produce in own region.

This paper has a few shortcomings which we could not overcome. It is the cause

and effect of the decline of border effect and the insignificance of the estimation in 1990. The former may come from the reduction of tariff rate, but in the case of Japan non-tariff barrier rather than tariff rate is said to play a crucial role in trade policy. Furthermore, in considering the influence of tariff rate, we should examine at the level of industries and goods, because tariff rate is different in goods and responsiveness to consumption and supply is also various in industries. Therefore we cannot insert the tariff rate into estimations easily. Gravity model at the level of industries or goods will be analyzed in the future. Furthermore, the latter may be caused by FDI to Asian countries. The border effect and FDI will be analyzed by Gravity model in the future, though this paper cannot cover enough. It will solve why border fades out in 1990, and find out the specific cause and effect of FDI to border effect.

Data Appendix 1 Components of Foreign Countries of 9 Areas in the World

This classification is based on the category by the World Bank.

-East Asia and Pacific: South Korea, North Korea, China, Taiwan, Hong Kong, Thailand, Singapore, Malaysia, Vietnam(formerly North Vietnam), Philippines, Indonesia, Myanmar(formerly Burma), Australia, New Zealand

-South Asia: India, Pakistan, Sri Lanka(formerly Ceylon)

-Middle East: Iran, Iraq, Saudi Arabia, Kuwait, Israel

-Eastern Europe and Central Asia: Russia (formerly USSR)

-Rest of Europe: Sweden, UK, Netherlands, Belgium, France, Germany(formerly West German), Denmark, Switzerland, Spain, Italy

-Americas: Canada, US, Mexico, Guatemala, El Salvador, Nicaragua, Venezuela, Peru, Chile, Brazil, Argentina,

-East and South Africa: South Africa, Zimbabwe, Zambia,(formerly Rhodesia)

-West Africa: Liberia

-North Africa: Egypt (formerly United Arab Emirates)

Data Appendix 2 Components of Prefectures of 9 Regions in Japan

This classification is based on the category by Ministry of International Trade and Industry..

-Hokkaido

-Tohoku: Aomori, Akita, Yamagata, Iwate, Miyagi, Fukushima

-Kanto : Niigata, Ibaraki, Tochigi, Gunma, Saitama, Chiba, Tokyo, Kanagawa, Yamanashi, Nagano, Shizuoka

-Chubu: Toyama, Aichi, Ishikawa, Gifu, Mie

-Kinki: Fukui Shiga, Osaka, Kyoto, Hyogo, Wakayama, Nara

-Chugoku: Okayama, Hiroshima, Shimane, Tottori, Yamaguchi

-Shikoku: Kagawa, Ehime, Kochi, Tokushima

·Kyusyu: Saga, Fukuoka, Oita, Nagasaki, Kumamoto, Miyazaki, Kagoshima

·Okinawa (1975·) (It was treated as a part of the rest of the world before 1975.)

Data Appendix 3 Components of Foreign Countries in the Regression on Okinawa in 1990

Export Countries from Okinawa: Taiwan, Hong Kong, China, South Korea, US, Philippines, Thailand, Singapore, Malaysia, Indonesia, Myanmar, Pakistan, Iran, Belgium, France, Germany, Italy.

Import Countries to Okinawa: Taiwan, Hong Kong, China, South Korea, Thailand, Singapore, Malaysia, Philippines, Indonesia, Myanmar, Australia, New Zealand, Pakistan, Iran, Iraq, Saudi Arabia, Kuwait, Israel, Oman, Arab, Sweden, Finland, UK, Netherlands, Belgium, France, Germany, Denmark, Greek, Switzerland, Spain, Italy, Canada, US, Mexico, Venezuela, Brazil, Argentina, South Africa

Data Appendix 4 Sources of Data

The data on interregional trade between regions in Japan is from *Input-Output Tables of Interregional Relations*(1960·1990) (Ministry of International Trade and Industry). Nominal GDP in foreign countries is from *World Bank Atlas* (World Bank). GDP in regions in Japan is calculated from *Kenmin Keizai Keisan Nenpou* (Economic Planning Agency). The data on international trade between Japan and foreign countries is from *Gaikoku Boueki Gaikyou* (Ministry of Finance). Foreign trade in Okinawa comes from *Okinawa Keizai Toukei Nenkan* (Okinawa·ken)

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